

What is claimed is:

1. An RF module comprising:

a first waveguide for propagating electromagnetic waves in a TEM mode; and

a second waveguide connected to the first waveguide, for propagating electromagnetic waves in another mode different from the TEM mode,

wherein the second waveguide has a region surrounded by at least two ground electrodes facing each other and conductors for bringing at least two ground electrodes into conduction, electromagnetic waves propagate in the region,

the first waveguide extends in a stacking direction of the ground electrodes, an end of the first waveguide is directly conductively connected to one of the ground electrodes of the second waveguide from the stacking direction side, and

magnetic fields of the first and second waveguides are coupled in an H plane of the second waveguide so that the direction of the magnetic field of electromagnetic waves propagated in the first waveguide and that of the magnetic field of electromagnetic waves propagated in the second waveguide match with each other.

2. An RF module according to claim 1, wherein the second waveguide is to propagate electromagnetic waves in a TE mode.

3. An RF module according to claim 1, wherein a window formed by partially opening the ground electrode is provided in a connection portion between the first and second waveguides.

4. An RF module according to claim 1, wherein the second waveguide has a structure including a plurality of propagation regions for propagating electromagnetic waves in different directions and

a magnetic field from an end portion of the first waveguide is coupled in a boundary portion of the plurality of propagation regions in the second waveguide.

5. An RF module according to claim 4, wherein a magnetic field from an end portion of the first waveguide is connected in a boundary portion of the plurality of propagation regions in the second waveguide so that electromagnetic waves propagated through the first waveguide propagate so as to be branched into the plurality of propagation regions in the second waveguide.

6. An RF module according to claim 1, wherein the second waveguide is to propagate electromagnetic waves in a multiple mode.

7. A mode converting structure for converting a mode between different waveguides of: a first waveguide for propagating electromagnetic waves in a TEM mode, and a second waveguide connected to the first

waveguide, for propagating electromagnetic waves in another mode different from the TEM mode,

wherein the second waveguide has a region surrounded by at least two ground electrodes facing each other and conductors for bringing at least two ground electrodes into conduction, electromagnetic waves propagate in the region,

the first waveguide extends in a stacking direction of the ground electrodes, an end of the first waveguide is directly conductively connected to one of the ground electrodes of the second waveguide from the stacking direction side, and

magnetic fields of the first and second waveguides are coupled in an H plane of the second waveguide so that the direction of the magnetic field of electromagnetic waves propagated in the first waveguide and that of the magnetic field of electromagnetic waves propagated in the second waveguide match with each other.

8. A method for converting a mode in a structure comprising: a first waveguide for propagating electromagnetic waves in a TEM mode; and a second waveguide connected to the first waveguide, for propagating electromagnetic waves in another mode different from the TEM mode, the second waveguide having a region surrounded by at least two ground electrodes facing each other and conductors for bringing at least two ground electrodes into conduction, and electromagnetic waves propagating in the region,

wherein the first waveguide extends in a stacking direction of the ground electrodes, an end of the first waveguide is directly conductively connected to one of the ground electrodes of the second waveguide from the stacking direction side, and

magnetic fields of the first and second waveguides are coupled in an H plane of the second waveguide so that the direction of the magnetic field of electromagnetic waves propagated in the first waveguide and that of the magnetic field of electromagnetic waves propagated in the second waveguide match with each other.